(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 May 2004 (21.05.2004)

PCT

(10) International Publication Number
WO 2004/042997 A1

(51) International Patent Classification[7]: H04L 9/32

(21) International Application Number:
PCT/EP2003/009063

(22) International Filing Date: 14 August 2003 (14.08.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
MI2002A 002339 5 November 2002 (05.11.2002) IT

(71) Applicants and
(72) Inventors: **STIGLIANI, Domenico** [IT/IT]; Via Pavese 2, I-47037 Rimini (IT). **STIGLIANI, Faustino, Nicola** [IT/IT]; Via Blansko 23, I-42019 Scandiano (RE) (IT). **RUCCO, Paolo** [IT/IT]; Via Pistoni e Blosi 5, I-42019 Scandiano (RE) (IT).

(74) Agent: **FARAGGIANA, Vittorio**; Guzzi e Ravizza s.r.l., Via Vicenzo Monti 8, I-20123 Milano (IT).

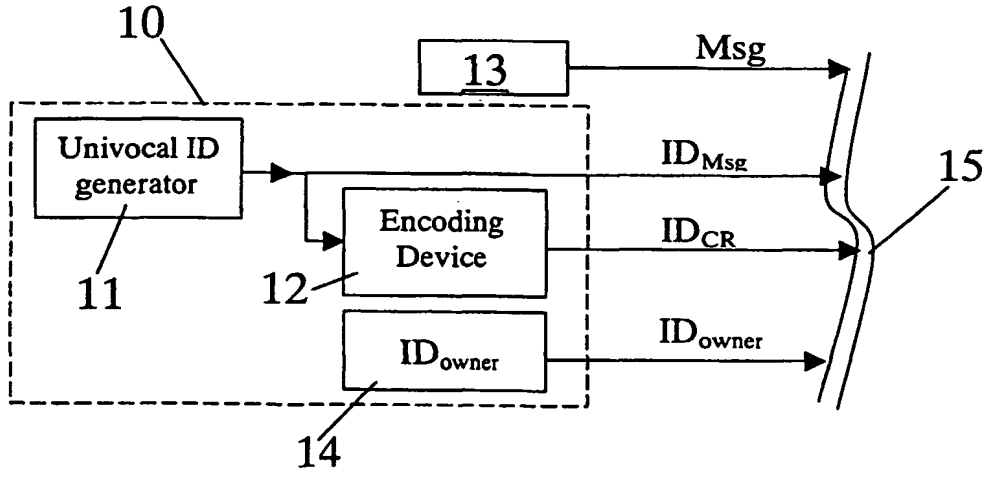
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND DEVICES FOR PERFORMING SECURITY CONTROL IN ELECTRONIC MESSAGE EXCHANGES



(57) Abstract: A method for verifying the security of a message (Msg) transmitted and received in electronic form comprises on the transmitting side the steps of associating with the message a univocal message identifier (IDMsg) and a message owner identity checking identifier (IDCR) which is obtained by applying to the univocal message identifier (IDMsg) an encoding (12) associated with the owner of the message to be transmitted. On the receiving side the method comprises the steps of verification and signaling of the fact of having or not having already received a message with the same univocal message identifier (IDMsg) associated and ascertaining agreement between the univocal message identifier (IDMsg) associated with the received message and the result (IDDCR) of a decoding of the checking username (IDCR). A verification system and device in accordance with the method are also discussed.

WO 2004/042997 A1

"METHOD AND DEVICES FOR PERFORMING SECURITY CONTROL IN ELECTRONIC MESSAGE EXCHANGES"

The present invention relates to a method and devices for performing security control in electronic message exchanges and in particular for monetary transactions such as those made with credit or debit cards and the like.

Security problems in the exchange of messages in electronic form and especially over intrinsically unsafe networks like for example the networks making up Internet are known.

Among the various problems there can be listed the possibility that someone might generate messages (in particular, monetary transaction requests) by falsifying the owner of the message and the possibility that actual messages might be duplicated to obtain that a request contained in the message be met again.

In the prior art it has been sought to remedy some aspects of these problems, for example by introducing systems like the so-called 'electronic signature' which however allows having reasonable certainty of the identity of the owner of the message but not of the uniqueness of the message.

Known systems are however in general complicated and difficult to apply and/or they generate an overload in the processing and/or transmission of messages which are not always acceptable and especially in the case of applications which they produce and must manage a high number of message in relatively short times such as for example with monetary transactions by credit or debit card and especially if used to pay for goods or services on

internet or in stores having POS terminals or the like.

The general purpose of the present invention is to remedy the above mentioned shortcomings by making available a method and devices for security verification in the exchange of messages electronically which would be fast, easy to apply and intrinsically reliable.

In view of this purpose it was sought to provide in accordance with the present invention a method for verifying the security of a message transmitted and received in electronic form which on the transmitting side comprises the steps of associating with the message for its later security verification a univocal message identifier and an identifier for control of the identity of the owner of the message with the control identifier being obtained by applying to the univocal message identifier an encoding associated with the owner of the message to be transmitted, and on the receiving side for security verification of a received message comprises the steps of verification and signaling of the fact of having or not having already received a message with the same univocal identifier of the associated message, applying a decoding associated with a supposed owner of the received message to the checking identifier of the owner associated with the received message, and ascertaining and signaling the agreement or not between the univocal message identifier associated with the received message and proven to be said decoding of the control username.

Again in accordance with the present invention it was sought to realize a system for safety verification of a

message transmitted and received in electronic form comprising on the transmitting side a univocal username generator of a message, and an encoding device receiving the message username produced by the generator and encoding it in accordance with a code associated with the owner of the message to be transmitted to obtain therefrom an identifier for checking the identity of the message owner, and transmission means associating with the message to be transmitted the checking identifier and the univocal message identifier obtained, and on the receiving side comprises for safety verification of a received message a checking device which verifies and signals that the message identifier associated with the received message has of has not been received previously, and a decoding device which receives the owner checking identifier associated with the received message and applies thereto a decoding associated with a supposed owner of the received message, and verification means which ascertain and signal the agreement or not of the univocal message identifier with the result of the decoding of the checking username.

Again in accordance with the present invention it was also sought to realize a device for association of security verification factors with a message transmitted in electronic form characterized in that it comprises a univocal message username generator, an encoding device receiving the message username produced by the generator and encoding it in accordance with a code associated with the owner of the message to be transmitted to obtain therefrom an identifier for checking the identity of the

message owner, and means which associate with the message to be transmitted the checking identifier and the univocal message identifier obtained.

To clarify the explanation of the innovative principles of the present invention and its advantages compared with the prior art there is described below with the aid of the annexed drawings a possible embodiment thereof by way of non-limiting example applying said principles. In the drawings:

FIG 1 shows a block diagram of a device or part on the transmitting side of a security verification system realized in accordance with the present invention,

FIG 2 shows a block diagram of a device or part on the receiving side of a security verification system realized in accordance with the present invention, and

FIG 3 shows diagrammatically a possible combination of information in accordance with the method of the present invention.

With reference to the figures, FIG 1 shows the part on the transmitting side designated as a whole by reference number 10 of a security system realized in accordance with the present invention. This part or device 10 comprises a generator 11 for generation of a univocal message username (designated by ID_{Msg}) and an encoding device 12 which receives the message username ID_{Msg} produced by the generator and encodes it to obtain an encoded version thereof called here identifier ID_{CR} which will be usable as clarified below as the identifier for checking the identity of the message owner.

The device 10 is associated with a known system 13 (not described here as it is well known and readily imaginable to those skilled in the art) for production of messages Msg to be transmitted and of which it is wished to ensure the security offered by the present invention. These messages can be conventional electronic messages for management of monetary transactions of, for example, a credit or debit card circuit.

The generator 11 is a known generator of single keys. It can be realized either as hardware or software, for example the known GUID generator of Microsoft. Its main operational principle is based on the random generation of a key or ID sufficiently long to make the probability of generating two identical keys practically zero. For each message to be sent, the generator therefore produces an identifier which can be represented by a sequence of bits, numbers, characters et cetera and which is the only one and will never be used again. This ensures that no "twin" keys exist.

The ID of the message (which can also be called LEFT KEY) is surely to be understood therefore as a key but produced before and thus a new key.

The encoding device 12 encodes the ID_{Msg} so as to obtain a username ID_{CR} containing the ID_{Msg} in a concealed manner making it possible if the correct decoding is known to go back to it or at least to a representation thereof allowing knowing whether ID_{CR} was really created by correct encoding of ID_{Msg}. The ID_{CR} can also be called RIGHT KEY.

With a message Msg are thus associated the two usernames

(unique for each message) ID_{Msg} and ID_{CR}. As clarified below, the former allows knowledge of the uniqueness of a message while the second allows having confirmation of the identity of the owner who produced the message or to whom it refers. Indeed, encoding of ID_{Msg} in ID_{CR} is done in accordance with a code which was previously associated with the owner of the message to be transmitted. For example it is advantageous that the encoding and the following corresponding decoding be realized as encryption and decryption operations with a key and with a particular key or algorithm associated with the particular owner of the message. In particular, such encryption and decryption can be advantageously of the known public/private key type in which the encryption is done by the encoding device 12 using the private secret key of the owner who sends the message or to whom it refers.

Once the usernames to be associated with the message are obtained they can be sent to the receiving part of the system through a suitable known transmission means, for example internet, dedicated networks, telephone lines et cetera. The transmission means and the paths followed by the various usernames and the message can be the same for all or different from each other depending on specific requirements or desires.

ID_{Msg} and ID_{CR} can also be assembled in a single compound identifier ID_T which can also be called SUPER KEY = LEFT KEY + RIGHT KEY.

If a single transmission means is used, the usernames and the message can be assembled in a single total MSG_T

message. All this is shown clearly in FIG 3. If desired, this total message can be in turn encrypted in accordance with known techniques.

In one embodiment of the present invention the message is also associated with a username ID_{owner}, unique for each possible owner of the message to be transmitted. For example, in case of a transaction by credit card said ID_{owner} can be the card number. This ID_{owner} can be produced or extracted by means 14, for example a programmed electronic memory, manual input means or reading means of owner data contained on a card used in the transaction. This ID_{owner} can also be used to control correct encoding in the encoding device 12.

Known methods of combination of the various parts and possible known transmission codifications even dependent on the particular means of transmission and even desired for implementation of additional security levels can be used. All this is readily imaginable to those skilled in the art and is not further discussed or shown.

FIG 2 shows the part designated as a whole by reference number 16 of the system in accordance with the present invention present on the message receiving side.

To verify the security of a received message (Msg) (which can be processed in accordance with the intended use of the message by any known processing system 17, for example a transaction manager not further discussed here, said receiving part 16 comprises a control device 18 to recognize whether an ID_{Msg} associated with a received message has not been received previously. For recognition,

the device 18 manages an archive of previously used IDs 19. Every time an ID_{Msg} arrives the device checks in the archive 19 whether it has already been memorized and issues a corresponding ID acceptable or unacceptable signal 20. If the ID has not been used yet the associated message is considered new and the ID is memorized in the archive to prevent future new use.

The receiving part 16 also comprises a decoding device 21 which receives the control identifier of the owner ID_{CR} associated with the received message and applies to it a decoding associated with a supposed owner of the received message. At outlet from the decoder an identifier ID_{DCR} is thus obtained. The decoding is realized in such a manner that there is a predetermined agreement between ID_{Msg} and ID_{DCR} if the ID_{CR} had been obtained for encoding of the ID_{Msg} by the method associated with the message owner.

Verification means 22 receive the ID_{Msg} and ID_{DCR} and ascertain and signal with a signal 23 the existence or not of said predetermined agreement. If there is agreement the message can be considered as belonging to its legitimate owner. If both the conditions at the outlets 20 and 23 are verified positively the device 16 emits a positive verification signal 24 and the message Msg associated with the usernames received can be considered acceptable on the basis of the security verification in accordance with the present invention.

As may be seen again in FIG 2, the agreement signal 23 can also be sent to the sole ID recognizer 18 so as to inhibit memorization of the message ID among the IDs already used

in case agreement between ID_{Msg} and ID_{CR} is not found. This avoids useless memorization of 'false' IDs among the IDs already used. The decoding device 21 will usually operate in reverse of the encoding device 12 in such a manner that if the encoder 12 obtains a certain ID_{CR} from a specific ID_{Msg} the decoder will again obtain the same ID_{Msg} starting form the ID_{CR}. In this case the agreement verification made by the device 22 will be a verification of sameness among received ID_{Msg} and decoded ID_{CR}.

If, as mentioned above, the encoder makes a key encryption the decoder will make a corresponding key decryption. The keys associated with the owners will be memorized in a purposeful key archive 25.

For example if the encryption system chosen is with public/private key, the decoder will perform a decryption as called for by said known system by using the appropriate key corresponding to the owner associated with the message. In accordance with one aspect of the present invention, if on the transmitting side the above mentioned owner identifier (ID_{owner}) is also associated with the message, on the receiving side the decoding to be applied can advantageously be selected from among a plurality of possible decodings on the basis of the owner identifier associated with the received message. Selection of the right key from the archive 25 thus becomes much faster since the ID_{owner} is supplied to the decryption device 21 as a search index for the right key in the key archive 25.

It is now clear that it is possible to realize a device 10 for association of safety verification factors with a

message transmitted in electronic form and a system 10, 16 for a security verification of a message transmitted and received in electronic form and a method for a security verification of a message transmitted and received in electronic form.

As readily imaginable to those skilled in the art, the practical realization can be totally software, totally hardware or mixed.

The device 10 can also be realized in portable form (for example a smart card) to be supplied for example to a credit card owner who can thus generate an ID_T or SUPER KEY to be supplied together with the other data (amount to be debited thereto, card number et cetera) for payment by card. These data can be considered the message MSG and if necessary encrypted in accordance with a known system.

As an alternative the device could be kept at the store where the purchase is made and the card owner could input therein in a reserved manner the encoding key for production of the RIGHT KEY part of the SUPER KEY which would thus be generated by the apparatus.

The security of the system in accordance with the present invention is evident from the above description.

The SUPER KEYs are to be considered public as they are transmitted over channels which are intrinsically unsafe but which conceal within them in protected mode the univocity of both the message and the owner.

An organization supplying the above mentioned service could supply to the customer an adequate hardware and/or software support (even directly integrated in an 'intelligent'

credit card) and by means of this support the customer would be able to send the SUPER KEY generated through either a private or a public position. The SUPER KEY can cover (in the example of the monetary transaction) the same steps covered by the information of the normal credit or debit card. The SUPER KEY once used is recorded in the database of the organization and thus becomes inactive. Whoever tried to reuse it would nullify the request and interception of the SUPER KEY is thus useless. The SUPER KEY can also be understood as 'single use' identification. A dishonest user could refuse to use his own unique key generator but steal one of the keys already produced by another user and create a twin thereof. The key would however be unusable because each time a user makes a transaction by using the generator of unique keys, the key generated is added to the list present in the organization's database. The database contains the list of all the LEFT KEYs produced over time and only LEFT KEYs, not RIGHT or SUPER KEYs, and ensures that the keys already produced are unusable. The predetermined biunivocal agreement between the user and the corresponding algorithm or encoding/decoding key with the corresponding archive of keys and/or algorithms with the organization ensures the possibility for the organization to really distinguish two users and reject counterfeit requests or messages. Since the message uniqueness identifier reaches the organization both in clear and encoded form it is impossible to falsify only the message uniqueness identifier within a SUPER KEY. Naturally the above description of an embodiment applying

the innovative principles of the present invention is given by way of non-limiting example of said principles within the scope of the exclusive right claimed here.

For example the message MSG can be of any known type, even encrypted, to be decrypted upon arrival in accordance with any known method. These operations can also be performed by the same devices 12, 21 which encode and decode the message identifier.

The message identifier can also be assembled with the message before encoding and the encoding can then be performed on the result of the assembly to have an identifier ID_{CR} incorporated in encrypted form in the transmitted message to then be decoded and extracted on the receiving side.

The owner identifier can be a specific identifier assigned by the manager of the service or a unique already existing identifier chosen conventionally. For example in the case of a natural person owner, his taxpayer's code number, driving license number, credit card number et cetera may be used.

CLAIMS

1. Method for security verification of a message (Msg) transmitted and received in electronic form which:

- on the transmitting side comprises the steps of associating with the message for its subsequent security verification a univocal message identifier (ID_{Msg}) and an identifier (ID_{CR}) for checking the identity of the message owner with the checking identifier (ID_{CR}) being obtained by applying to the univocal message identifier (ID_{Msg}) a coding associated with the owner of the message to be transmitted, and
- on the receiving side for security verification of a received message (Msg) comprises the steps of:
  - verifying and signaling the fact of having or not having received a message previously with the same univocal message identifier (ID_{Msg}) associated,
  - applying a decoding associated with a supposed owner of the received message to the checking identifier of the owner (ID_{CR}) associated with the received message, and
  - ascertaining and signaling the agreement or not between the univocal message identifier (ID_{Msg}) associated with the received message and the result (ID_{DCR}) of said decoding of the checking username (ID_{CR}).

2. Method in accordance with claim 1 in which before transmission the univocal message identifier (ID_{Msg}) and the

identifier (ID_{CR}) for checking the identity of the message owner are assembled in a unique compound identifier (ID_T).

3. Method in accordance with claim 1 in which on the transmitting side at least the checking identifier (ID_{CR}) is assembled with the message and transmitted therewith.

4. Method in accordance with claim 3 in which the assembling takes place by inserting the message identifier (ID_{Msg}) in the message (Msg) and applying the coding to the result of the insertion.

5. Method in accordance with claim 1 in which on the transmitting side, with the message to be transmitted is also associated an owner identifier (ID_{owner}) and on the receiving side the decoding to be applied is selected from among a plurality of possible decodings on the basis of the owner identifier (ID_{owner}) associated with the received message.

6. Method in accordance with claim 1 in which the coding and decoding are keyed encryption and decryption operations.

7. Method in accordance with claim 3 in which encryption and decryption are the type with public/private key.

8. Method in accordance with claim 1 in which ascertainment of the agreement between univocal message identifier (ID_{Msg}) associated with the message received and the result of the decoding of the checking username (ID_{CR}) consists of verifying the sameness between said univocal message identifier (ID_{Msg}) and the result of the decoding of the checking username (ID_{CR}).

9. System for a safety verification of a message (Msg)

transmitted and received in electronic form and comprising:

- on the transmitting side:
  - a univocal message username generator (ID_{Msg}),
  - an encoding device which receives the message username (ID_{Msg}) produced by the generator and codifies it in accordance with a code associated with the owner of the message to be transmitted to obtain therefrom an identifier (ID_{CR}) for checking the identity of the message owner,
  - transmission means which associate with the message to be transmitted the checking identifier (ID_{CR}) and the univocal message identifier (ID_{Msg}) obtained,
- on the receiving side for security verification of a received message (Msg):
  - a control device which verifies and signals that the message identifier (ID_{Msg}) associated with the received message has or has not been received previously,
  - a decoding device which receives the owner checking identifier (ID_{CR}) associated with the received message and applies thereto a decoding associated with a supposed owner of the received message,
  - verification means which ascertain and signal the agreement or not of the univocal message identifier (ID_{Msg}) with the result of

the decoding of the checking username (ID_{CR}).

10. System in accordance with claim 8 characterized in that the encoding and decoding devices are keyed encryption and decryption devices.

11. System in accordance with claim 9 characterized in that the encryption and decryption devices are the public/private key type.

12. Device for association of security verification factors with a message transmitted in electronic form characterized in that it comprises:

- a univocal message username generator (ID_{Msg}),
- an encoding device which receives the message username (ID_{Msg}) produced by the generator and encodes it in accordance with a code associated with the owner of the message to be transmitted to obtain therefrom an identifier (ID_{CR}) for checking the identity of the message owner,
- means which associate with the message to be transmitted the checking identifier (ID_{CR}) and the univocal message identifier (ID_{Msg}) obtained.

13. Device in accordance with claim 12 characterized in that the encoding device is a keyed encryption device.

14. Device in accordance with claim 12 characterized in that it issues a compound identifier (ID_T) made up of the combination of the univocal message identifier (ID_{Msg}) and the identifier (ID_{CR}) for checking the identity of the message owner.

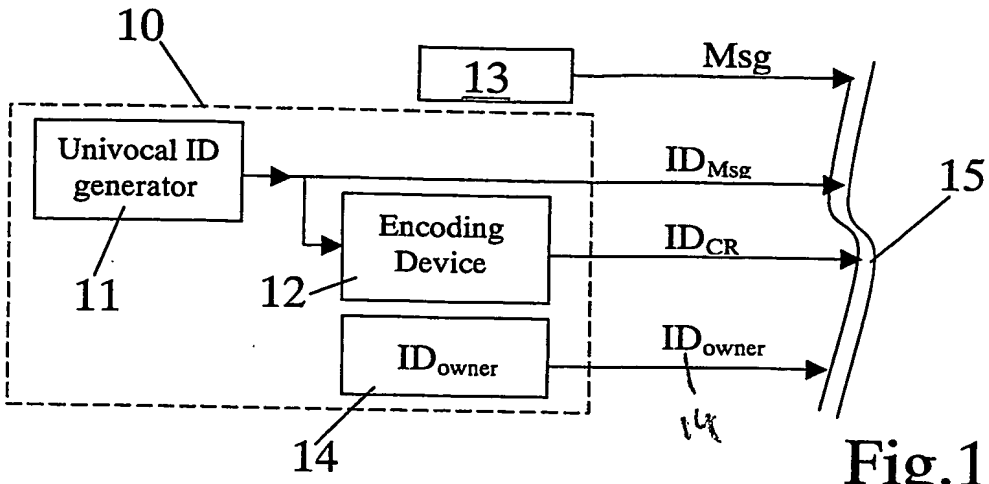


Fig.1

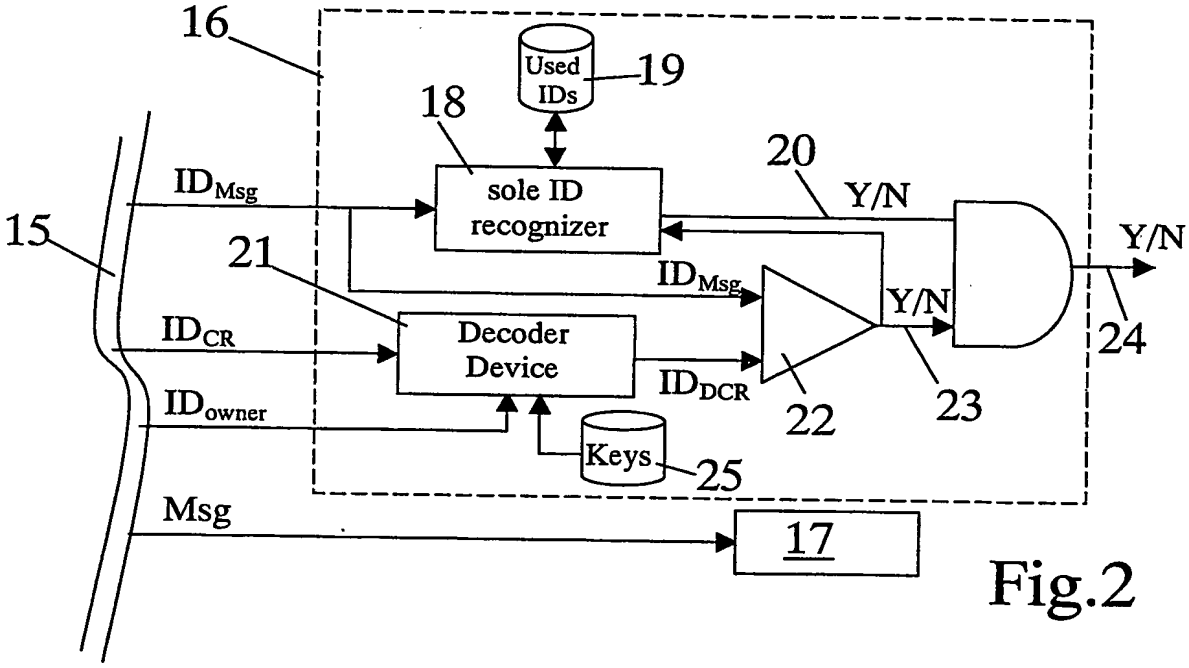


Fig.2

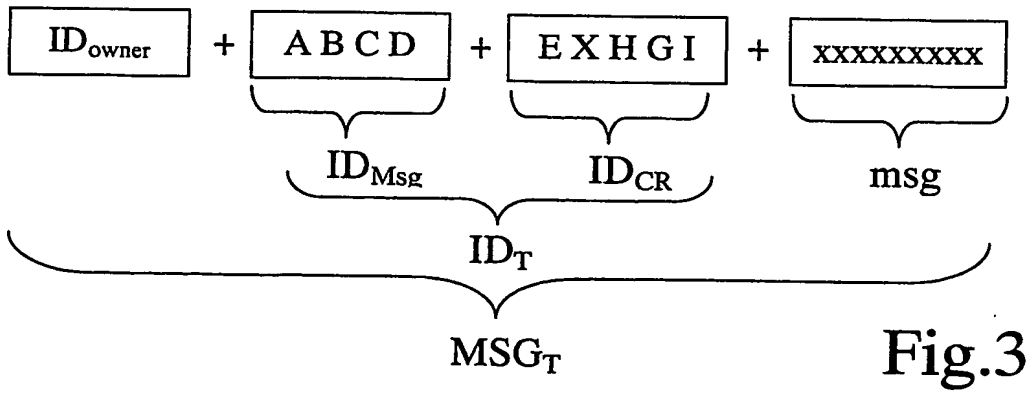


Fig.3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/09063

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L9/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, IBM-TDB, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00 35143 A (COLLINS LYAL SIDNEY ;VIRTUAL BUSINESS ASSOCIATES PT (AU)) 15 June 2000 (2000-06-15) page 13, line 18 -page 14, line 2 page 17, line 20 -page 18, line 5 figures 5,8 ---	1-14
A	US 5 475 763 A (KAUFMAN CHARLES W ET AL) 12 December 1995 (1995-12-12) column 3, line 9 - line 37 claims 1,5 --- -/--	1-14

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 December 2003	13/01/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Cretaine, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/09063

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	CHRISTOFFERSSON P: "MESSAGE AUTHENTICATION AND ENCRYPTION COMBINED" COMPUTERS & SECURITY, ELSEVIER SCIENCE PUBLISHERS. AMSTERDAM, NL, vol. 7, no. 1, 1 February 1988 (1988-02-01), pages 65-71, XP000117563 ISSN: 0167-4048 the whole document ---	1-14
A	W.C.MARTIN: "Message Replay Prevention Using a Previously Transmitted Random Number to Sequence the Messages" IBM TECHNICAL DISCLOSURE BULLETIN, vol. 27, no. 3, August 1984 (1984-08), pages 1758-1759, XP002264866 US the whole document -----	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 03/09063

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 0035143	A	15-06-2000	AU	754026 B2	31-10-2002
			AU	1761800 A	26-06-2000
			WO	0035143 A1	15-06-2000
			EP	1135887 A1	26-09-2001
			JP	2002532741 T	02-10-2002
			NZ	512655 A	28-08-2002
US 5475763	A	12-12-1995	NONE		